

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Kennedy et al.

Examiner:

Serial No:

Group Art Unit:

Filed:

Date:

December 8, 2000

For: **ADDITION OF UNSATURATED HYDROCARBONS TO POLY(VINYL CHLORIDE) AND FUNCTIONALIZATION THEREOF**



Assistant Commissioner for Patents
Washington, D.C. 20231

INFORMATION DISCLOSURE STATEMENT

Sir:

This invention relates to the preparation of allylated poly(vinyl chloride) by utilizing an allyltrialkylsilane in the presence of Friedel-Crafts acids. The pendant allyl groups can be further reacted through various functionalization reactions to contain end groups such as epoxy and hydroxyl. Alternatively, an unsaturated group can be added to poly(vinyl chloride) utilizing a diene also in the presence of a Friedel-Crafts acid. These pendant groups can also be reacted to contain functional end groups such as hydroxyl and epoxy. In yet a further embodiment, the functionalized end groups such as pendant -OH groups of both the allylated and diene grafted poly(vinyl chloride) are further reacted with other monomers or polymer chains which thus results in a poly(vinyl chloride) chain having pendant monomers or polymers. These compositions are useful as compatibilizers for poly(vinyl chloride) and various other resins.

As authorized and encouraged under 37 C.F.R. §1.97 – 1.99, Applicant hereby cites as a means of complying with the duty of disclosure set for in 37 C.F. R. §1.56, the following patents and or documents, copies enclosed, which the Examiner should consider with respect to the above-identified U.S. Patent Application.

PATENT APPLICATION TRANSMITTAL LETTER TO THE COMMISSIONER OF PATENTS AND TRADEMARKS Transmitted

herewith for filing is the patent application of: Joseph P. Kennedy and Zhengjie Pi

For: **ADDITION OF UNSATURATED HYDROCARBONS TO POLY(VINYL CHLORIDE) AND FUNCTIONALIZATION THEREOF**

Enclosed are:

- ☐ sheets of drawings (☐ formal - informal)
- ☒ an assignment of the invention to University of Akron, Akron, Ohio
- ☒ an assignment recordation cover sheet
- ☐ a certified copy of a _____ application.
- ☐ an associate power of attorney
- ☐ a verified statement to establish small entity status under 37 CFR §1.9 and §1.27.

JCS11 U.S. PTO
09/732967
12/08/00

Claims as Filed					Small Entity			Other Than A Small Entity	
For	No. Filed		No. Extra		Rate	Fee	Or	Rate	Fee
Basic Fee						\$ 355			\$710
Total Claims	53	-20 =	33	*	X \$9 =	\$	Or	X \$18 =	\$594
Indep. Claims	7	-3 =	4	*	X \$40 =	\$	Or	X \$80 =	\$320
Multiple Dependent Claims Present					+\$135 =	\$ -0-	Or	+\$270 =	\$0
						Total \$	Or		Total \$1,624.00

* If the difference in Col. 1 is less than zero, enter "0" in Col. 2

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- ☒ A check in the amount of \$40.00 is enclosed to cover the Assignment recording fee.
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- ☒ A check in the amount of \$1624.00 to cover the filing fee is enclosed.
- ☒ The Commissioner is hereby authorized to charge payment of the following fees associated with this communication or credit any overpayment to **Deposit Account No. 08-3150**. A duplicate copy of this sheet is enclosed.
- ☒ Any additional filing fees required under 37 CFR §1.16.
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- ☒ Any filing fees under 37 CFR §1.16 for presentation of extra claims.
- ☐ Any patent application processing fees under 37 CFR §1.17.
- ☐ The issue fee set in 37 CFR §1.16 at or before mailing of the Notice of Allowance, pursuant to 37 CFR §1.311(b).

DEC 8, 2000

Date:

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The following are patents and/or documents, copies enclosed, which the Examiner should consider with respect to the above-identified United States Patent Application:

US PATENT/DOCUMENT		
PATENT/DOCUMENT NO.	DATE	NAME
5,578,743	11/26/96	Ho et al.
5,387,664	02/07/95	Kawasaki et al.
5,260,389	11/09/93	Resconi et al.
5,208,304	05/04/93	Waymouth
5,104,956	04/14/92	Waymouth
4,605,704	08/12/86	Eastman et al.
4,363,903	12/14/82	Yamane et al.
4,032,594	06/28/77	Serratore et al.
3,804,919	04/16/74	Schrage et al.
3,472,830	10/14/69	Baxter et al.
3,435,020	03/25/69	Olson
3,291,782	12/13/66	Anderson et al.
2,612,493	09/30/52	Sparks et al.
2,384,975	09/18/45	Sparks et al.
ARTICLES		
Encyclopedia of PVC, Vol. 1, 2 nd Ed., Marcel Dekker, Inc. New York, (1986); pp. 570-605		
<i>Heat Degradation of PVC Stabilized by Treatment with Alkylaluminum Compounds</i> , Gupta and Kennedy, <u>Makromol.Sci.-Chem.</u> , A12(10), (1978) 1407-1426		
<i>The Discoloration of PVC-I, Correlation Between the Dehydrochlorination and Discoloration of PVC</i> , Levai and Ocskay, <u>European Polymer Journal</u> , Vol. 10, (1974), pp. 1121-1125, Pergamon Press		
<i>Living Carbocationic Polymerization. XXX. One-Pot Synthesis of Allyl-Terminated Linear and Tri-Arm Star Polyisobutylenes, and Epoxy- and Hydroxy-Telechelics Therefrom</i> , Ivan and Kennedy, <u>Journal of Polymer Science: Part A: Polymer Chemistry</u> , Vol. 28, (1990), pp. 89-104		
<i>Determination of Tertiary Chlorine Structures in PVC</i> , Buruiana, Airinei, Robila and Caraculacu, <u>Polymer Bulletin</u> 3, (1980), pp. 267-271		
<i>Graft Modification of PVC and Related Reactions</i> , Thame and Lundberg, <u>Journal of Polymer Science: Part A-1</u> , Vol. 10, (1972), pp. 2507-2525		
<i>Determination of Unsaturated Structures in PVC by Means of Fourier Transform ¹H-NMR Spectroscopy</i> , Caraculacu and Bezdadea, <u>Journal of Polymer Science: Polymer Chemistry Edition</u> , Vol. 15, (1977), pp. 611-620		
<i>Determination of Labile Chlorine in PVC with the Aid of Phenolysis Reaction</i> , Buruiana, Robila and Caraculacu, <u>European Polymer Journal</u> , Vol. 13 (1977) pp. 21-24, Pergamon Press		

New Approaches to the Study of Labile Structures in PVC by Phenolysis, Muangos, Martínez, and Millán, European Polymer Journal, Vol. 18, (1982), pp. 731-734, Pergamon Press

*New Telechelic Polymers and Sequential Copolymers by Polyfunctional Initiator-Transfer Agents (Inifers). III. Synthesis and Characterization of a Poly(α -Methylstyrene-*b*-Isobutylene-*b*- α -Methylstyrene)*, Kennedy and Smith, Journal of Polymer Science: Polymer Chemistry Edition, Vol. 18, 1539-1546 (1980).

New Telechelic Polymers and Sequential Copolymers by Polyfunctional Initiator-Transfer Agents (Inifers). XVII. Epoxy and Aldehyde Telechelic Polyisobutylenes, Kennedy, Chang, and Francik, Journal of Polymer Science: Polymer Chemistry Edition, Vol. 20, 2809-2817 (1982);

Thermal Stability of Graft Modifications of PVC and Related Materials, Abbas, Journal of Polymer Science: Polymer Chemistry Edition, Vol. 13, 59-68 (1975)

*Cationic Grafting: The Synthesis, Characterization and Physical Properties of Poly (Vinyl Chloride-*g*-Isobutylene)*, Kennedy and Davidson, Polymer Prepr., Am. Chem. Soc., Div. Polymer Chem., (1974) 15, 209-213

*Poly(vinyl Chloride-*g*-Butyl Rubber)*, Kennedy and Davidson, Journal of Polymer Science: Polymer Chemistry Edition, Vol. 14, 153-157 (1976)

*Cationic Polymerization of Isobutylene from Poly (vinyl Chloride): Physical Properties of Poly(vinyl Chloride-*g*-Isobutylene)*, Kennedy and Davidson, Journal of Applied Polymer Science: Applied Polymer Symposium 30, 51-72 (1977)

*Cationic Polymerization of Isobutylene from Poly (vinyl Chloride): Physical Properties of Poly(vinyl Chloride-*g*-Isobutylene)*, Kennedy and Davidson, Journal of Applied Polymer Science: Applied Polymer Symposium 30, 13-49 (1977)

Mechanism and Microstructure in the Free-Radical Polymerization of vinyl Chloride: Head to Head Addition Revisited, Starnes and Wojciechowski, Makromol. Chem. Macromol. Symp. 70/71, 1-11 (1993)

*New Structural and Mechanistic Chemistry in Polymerizations of Vinyl Chloride Initiated by Di-*tert*-alkylmagnesiums*, Benedikt et al., Macromolecules, 30, (1997), 10-21

Intramolecular Hydrogen Transfers in Vinyl Chloride Polymerization: Routes to Doubly Branched Structures and Internal Double Bonds, Starnes et al., Macromolecules, (1998) 31, 1508-1517

Thermal Degradation of some Model Compounds for Polyvinylchloride, Airinei et al., Polymer Bulletin, (Berlin) (1982), 7, 465-471

Formation of Anomalous Structures in PVC and Their Influence on the Thermal Stability: 2. Branch Structures and Tertiary Chlorine, Hjertberg and Sorvik, Polymer, (1983), 24, June, 673-684

*Poly(Vinyl Chloride-*g*-Styrene): Synthesis, Characterization, and Physical Properties*, Kennedy and Nakao, Journal of Macromol. Sci.-Chem., A12(2), pp. 197-207 (1978)

Structural Defects in Polyvinylchloride-I, Internal Unsaturation as Initiation Sites for Dehydrochlorination, Braun, Michel and Sonderhof, European Polymer Journal, Vol. 17, pp. 49-56, (1981), Pergamon Press,

<i>Monte Carlo Simulation of the Formation of Irregular Structures in Poly (vinyl chloride)</i> , Guyot, <u>Macromolecules</u> , (1986), 19, 1090-1096
<i>Unsaturated End Groups in PVC-III</i> , Bezdadea, Buruiana and Carculacu, <u>European Polymer Journal</u> , (1971), Vol. 7, pp. 1649-1660, Pergamon Press
<i>On the Mechanism of the Polymerization of Poly(vinyl chloride)</i> , Caraculacu, Buruiana and Robila, <u>Journal of Polymer Science: Polymer Chemistry Edition</u> , Vol. 16, 2741-2745 (1978)
<i>Working Party on Defects in the Molecular Structure of PVC and Their Relation to Thermal Stability: General Conclusions</i> , Guyot, <u>Journal of Vinyl Technology</u> , (1985), 7(2), 92-94
<i>Effects of Stabilizers During the Thermal Treatment of PVC. II. Correlation of Thermal Stability, Discoloration, and Stabilizer Exhaustion</i> , Czako, <u>Plasty Kauc.</u> , (1975), 12(9), 259-261
<i>Investigation of Thermal Degradation of PVC in the Solid State</i> , Levai, Ocskay, Szebeni, <u>Journal Macromol. Sci., Chem</u> (1978), A12(3), 467-477
<i>Colorimetric Characterization of the Discoloration of Thermally Treated PVC</i> , Thielert, Schliemann, Figge, Agnew, <u>Makromol. Chem.</u> (1975), 47(1), 129-40
<i>Formation of Anomalous Structures in PVC and Their Influence on Thermal Stability, I, Endgroup Structures and Labile Chlorine Substituted by Phenol</i> , Hjertberg and Soervik, <u>Journal Macromol. Sci., Chem.</u> (1982), A17(6), 983-1004
<i>Organic Chemistry</i> , 2 nd Edition, John McMurry, Cornell University, Brooks/Cole Publishing Company, Pacific Grove, California, 1988
<i>Designed Polymers by Carbocationic Macromolecular Engineering: Theory and Practice</i> , J. P. Kennedy and B. Ivan, Hanser Publishers, Munich, Vienna, New York, Barcelona, Distributed in the U.S.A. and in Canada by Oxford University Press, New York, 1992
<i>Encyclopedia of Polymer Science and Engineering</i> , Volume 11, D. Freitag et al., John Wiley & Sons, pp. 648-718, 1988

Copies of the publications are included for the express purpose of providing the Patent and Trademark Office with an ample opportunity to evaluate the same and to arrive at an independent assessment of their materiality, if any, with regard to the examination of the application.

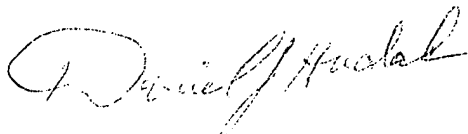
In reviewing the enclosed copies of the above publications, the Examiner is requested to ignore any underscoring or highlighting which may appear because such markings may or may not have any relationship to the subject matter of the

above-identified application. The copies being submitted with this Information Disclosure Statement are the best copies available at this time.

An official action considering the enclosed items is earnestly solicited.

Respectfully submitted,

HUDAK & SHUNK CO., L.P.A.

A handwritten signature in cursive script, appearing to read "Daniel J. Hudak", is written over a horizontal line.

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